Technical Committee Meeting
on the
STATUS OF SAFETY REPORTS OF WWER AND RBMK
NUCLEAR POWER PLANTS

Status of Safety Reports of Paks NPP

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Content

Abbreviations

AEFS	Auxiliary Emergency Feed-water System
AGNES	Advanced and Generally new Evaluation of Safety
CDF	Core Damage Frequency
HAEC	Hungarian Atomic Energy Commission
HAEA	Hungarian Atomic Energy Authority
HAEA NSD	HAEA Nuclear Safety Directorate (serves as Regulatory Body)
FSAR	Final Safety Analysis Report
NSC	Nuclear Safety Code
NSG	Nuclear Safety Guide
PSA	Probabilistic Safety Assessment
PSAR	Preliminary Safety Report
PSR	Periodic Safety Review
SAR	Safety Analysis Report
SAR-BC	Safety Analysis Report Before Construction
SAR-BS	Safety Analysis Report Before Start-up
TDD	Technical Design Document

1. Introduction

In Hungary at Paks four units of WWER-440/213 were put into operation from 1982 to 1987. At the very beginning the nuclear safety was established by the 9. Volume of the Technical Design Documents (TDD) delivered by the Soviet Vendor. In Hungary regarding safety analyses the early regulation required two versions of Safety Analysis Report (SAR): first was the SAR Before Construction (SAR-BC) and the second was the SAR Before Start-up (SAR-BC) which played the role of the Preliminary and Final Safety Analysis Reports (PSAR and FSAR) in the Hungarian licensing procedures. So SAR-BC and SAR-BS were finished by the mid of the eighties based on the TDD and other Russian backfitting documents. Next years in some cases SAR-BC and SAR-BS were updated partially in co-operation with the Russian Designer and Hungarian Research Institutes.

In the first part of the nineties a comprehensive reassessment of the plant safety was executed in the frame of the AGNES Project (Advanced and Generally New Evaluation of Safety) which took into consideration the up-to-date international requirements on nuclear safety evaluation. AGNES Project was sponsored by Paks NPP and the Hungarian Atomic Energy Commission (HAEC) and was co-ordinated by the Atomic Energy Research Institute in Budapest. In 1993 HAEC also decided for the future to require periodic renewal of the license of all Hungarian nuclear facilities carrying out on the base of Periodic Safety Reviews (PSR). First PSRs and license renewals had been executed by 1997 for 1&2 units and by 2000 for 3&4 units of Paks NPP. PSRs were based mainly on the results of AGNES Project and the reassessment of the condition of the plant systems.

In the nineties there was a continuous development in the regulatory system. The organisation of the Regulatory Body was established and developed according to the international processes. In 1996 after a detailed preparatory work a new Atomic Energy Act was codified and went into force from the beginning of 1997. It was followed by Governmental Decrees which laid down the structure of the Hungarian hierarchy of regulation and issued the five volumes of Nuclear Safety Codes (NSC). In parallel the Head of the Hungarian Atomic Energy Authority (HAEA) issued the first items of Nuclear Safety Guides (NSG). Up to now several items of NSG have been issued. In these documents already the concepts of PSAR and FSAR are used and in one of the Governmental Decrees an annual revision of FSAR (that is SAR-BS) was prescribed fixing the deadline of the first revision to the end of 1999 (it was modified later to the mid of 2000).

Since the structural and content requirements of FSAR given in the new regulations strongly differ from those of SAR-BS the first revision of FSAR needed a large amount of work. This first version has been submitted to the Regulatory Body and the evaluation process has just started. After the evaluation of FSAR is finished the decision on the approval will be waited at the beginning of the next year. At that point we can say that the status of FSAR of Paks NPP corresponds to the present international practice.

This paper describes the above mentioned milestones in more details.

2. Period of SAR-BC and SAR-BS

The construction of the first unit at Paks started in 1976. A Governmental Decree on nuclear safety and the Atomic Energy Act, however, was issued only in 1979 and 1980, respectively. Thus at the beginning the nuclear safety was established only by the TDD delivered by the Soviet Vendor. The first rules of the nuclear regulation declared the necessity of SARs separate from TDD that is making of SAR-BC and SAR-BS was prescribed. These documents were prepared in close co-operation with the Soviet Designer and mainly based on the TDD and other Russian backfitting documents. At that time the Hungarian Research Institutes had an expert function.

The content of SAR-BC and SAR-BS were basically acceptable at the level of that time. It was strengthened by the fact that the WWER-440 type of reactors have a considerable conservatism in safety margins. Nevertheless the analyses within these SARs were re-estimated from time to time and as the operational experiences accumulated at Paks some partial modifications of these SARs became necessary. These activities characterised the period of eighties. In these actions the Hungarian Research Institutes had already an active role.

After the large reactor accidents and because of the increased public attention on nuclear safety the rules for nuclear safety became more and more strict all over the world. It was reflected also in Hungary and therefore more attention was paid to the quality of SARs. In this atmosphere some shortages of the earlier SARs came into the focus of discussions from which the most important ones are as follows:

- The list of initiating events in the analyses was not complete.
- There was a lack of full input data and uncertainties.
- Poor information was available on the applied analytical tools and generally the conservatism of calculations was unknown.
- In many cases the analysis was terminated in a non-equilibrium state of the system and the further course and end of the process could not be assessed on the basis of parameter trends.
- In the cases of the differences between the existing and the designed plant no repeated analyses were carried out for SAR-BS.

It is important to stress again that the safe operation of the units were not affected by these deficiencies in a remarkable measure because of the above mentioned conservatism of the design.

In this situation at the beginning of the nineties it was decided to reassess the whole set of safety aspects and the AGNES Project was started in Hungary.

3. AGNES Project

The AGNES Project were initiated by the circumstances being characteristic ten years ago. These were that the previous SARs (SAR-BC and SAR-BS) had deficiencies, available analytical tools were advanced compared to those applied originally, there was an increased attention to nuclear safety from the public and authorities and the rules and requirements of the nineties became more strict and complex. The system of requirements incorporated both the system of acceptance criteria and the validation of tools and procedures applied for investigating the fulfilment of these criteria. The following aims were the basis for AGNES Project:

- A state of the art report on the reassessment of the nuclear safety of Paks NPP should be prepared.
- Those deterministic analyses of design basis accidents and severe accidents as well as probabilistic analyses should be carried out that are necessary for the preparation of the report.
- The priorities of safety enhancement measures should be determined.
- Preparations for elaborating an up-to-date safety report should commence.

The AGNES Project were based on the following conditions:

- To establish a complete input data base with references. In case of lacking data, values should be based on expert decisions.
- To apply the most internationally recognised computer codes with precise information on the conditions of their use.
- Best-estimate codes were recommended and the necessary and sufficient conservatism should be ensured in specifying the initial and boundary conditions.
- All details of the analyses (input data, modelling, nodalization, results) should be archived (for possible repetition of the calculations).
- The results of the analyses should be evaluated in accordance with the actual (being in force) acceptance criteria.

The results of AGNES Project justified the safe operation of the plant even taking into account the deficiencies of SAR-BS. It was pointed out that some approaches used in SAR-BS were not always acceptable, though the final safety conclusions of AGNES Project were in agreement with that of SAR-BS.

4. PSRs at Paks NPP

In 1993 HAEC issued a decision, which prescribed periodic renewal of the licenses of nuclear facilities in Hungary. Each renewal shall be based on a reassessment of nuclear safety and the state of the whole system. Reassessments shall be executed by the Operators and the results of these PSRs shall be submitted to the Regulatory Body in a Safety Report which gives the basis for the renewal of the license. Each procedures are finished by a decision of the Regulatory Body giving a new license for the next period and prescribing safety enhancing measures with fixed deadlines. Most of these latter come from the results of PSRs recommended by the Operator but after evaluating the submitted documents Regulatory Body may prescribe additional measures.

The first PSR at Paks was executed on the 1&2 units. Regulatory Body prepared its draft Guideline based on IAEA recommendations and after being agreed upon with experts issued it in 1955. The whole process finished in 1997.

The safety factors covered by this PSR were as follows

1. assessment of the actual physical condition of the plant,
2. equipment qualification,
3. safety analyses,
4. ageing and residual lifetime assessment,
5. safety performance and reliability indicators,
6. back-fitting of experiences from other NPPs and research findings,
7. procedures (internal regulation)
8. organisational structures and systems, administration,
9. human factors.

For the 3&4 units of Paks NPP PSR also was executed and this process finished in 2000. For the 3&4 units additional two safety factors were taken into account:

10. radiological environmental impact (releases, monitoring)
11. emergency preparedness (mainly on site).

As the result of PSR for 1&2 units only two essential changes of plant conditions required re-evaluation of design basis or needed separate actions: (1) extremely low water level of Danube river, (2) seismic risk of the site. Many other measures were prescribed but these did not affect the bases.

Without going into the very details three matters are to be mentioned.

As the result of the evaluation of the condition of 62 technological systems in 1-3 classes of Safety Classification of Components on the basis of eight criteria it could be declared that the plant components covered by PSR were in good condition.

Safety analyses based mainly on the national AGNES Project. Some updates had been made before the PSR, the results of which were involved into the PSR documents. For example within PSR the level-1 PSA analyses were executed involving shut-down PSA. As a result of PSA analyses the AEFS should be relocated and it decreased the CDF by about one order.

Finally it must be mentioned that since PSRs were executed according to the most up to date international recommendations the results can be utilised in much extent at the first revision of FSAR (see later).

5. New rules of nuclear regulation

In 1996 a new Atomic Energy Act was codified by the Hungarian Parliament and this law went into force from the beginning of 1997. Even in 1997 some of the Governmental Decrees followed this law and laid down the detailed rules on the use of nuclear energy for sectors by sectors of the State Administration. HAEA is responsible for the control of nuclear safety and the rules for this were issued in the Governmental Decree 108./1997. As Supplements to this Decree five volumes of Nuclear Safety Codes also were published. The main sources to the new regulation system were the Codes and Guides of IAEA.

Generally it can be said that the new regulation system among others fixed the results of the development processes of the previous years in a system of rules, that is many of the rules being valid on decision level were involved into NSCs. The above mentioned decision of HAEC from 1993 on PSRs is a good example for this.

The new regulation system uses already the concepts of PSAR and FSAR and in the above mentioned Decree an annual revision of FSAR was prescribed starting it in 1999 that is the deadline of the first revision was the end of 1999 (later modified to the mid of 2000). An other important change was the determination of the new structure of FSAR, which is practically identical with the well-known US NRC Reg. Guide 1.70 Rev.3. The structure of FSAR was fixed in the

Nuclear Safety Codes, Vol. 1., Appendix No. 2, *Content Structure of the Final Safety Report* (Based on US NRC Reg. Guide 1.70 Rev.3.)

supplemented to this paper in its original form.

6. Periodic renewal of FSAR

The annual renewal of FSAR is already a rule. During the first PSR process, however, it became clear that the first revision of FSAR will strongly differ from the later ones because of the large differences between the present content of SAR-BS and the prescribed structure of the future FSARs. It means that at the first step of this periodic activity much more work is needed than at later renewals. In other words the first revision can be considered like the construction of a new FSAR rather than the revision of the last version of SAR-BS.

FSAR has to be based on the following sources:

- SAR-BS,
- results of AGNES Project,
- results of PSRs,
- results of the safety analyses of the enhancing measures,
- technical documents of the safety enhancing measures.

Because of the large complexity of the task and the different status of the above listed source documents it was difficult to fix a reference date for the first version of FSAR. Finally March 31. of 1998. were selected and it means that the state of the plant at that time serves as reference in the first step for the validity of FSAR. Of course it is not a good situation because the difference between the date of the actual version of FSAR and its reference date is too large. But we hope that this difference will change quickly along the periodic revisions and after some years it decreases to an acceptable value below one year. Some parts of the FSAR, however, will be up to date because there is no sense to omit those information that are already available and do not disturb the whole logic of FSAR. For example the Chapters 13., 15., and 17. can be considered actual.

An important feature of the future FSARs is that in a certain version the modified pages will be marked so that every modification within the previous four revisions can be identified and beside the actual version the previous four versions will also be stored on computers. Thus any modification can be compared to the previous state within five years.

So, at present the first version of FSAR is under evaluation at the Hungarian Regulatory Body. The evaluation activity is governed by a Procedure issued by the Head of Regulatory Body. The main features of the evaluation are the following:

- The evaluation is made within the Regulatory Body.
- Almost the whole staff is involved.
- To every chapter of FSAR a team is connected with a team leader.
- In the evaluation period selected experts of the NPP may be invited for discussions to clarify problems. These are only informal discussions without any obligation.
- At the end of team activities a summarising period follows.
- Summarising can be resulted in two kind of decisions. If everything is all right, FSAR will be approved. If there will be shortages, modifications or a new revision will be prescribed. In this case the final point will be reached in an iterative process (probably with one more step).

The first (maybe also the last) decision is waited at the beginning of next year.

7. Conclusions

In summary it can be said that, hopefully, in Hungary the present level of the international treatment of safety analyses will be reached within a short time. To get this aim much effort has been taken during the previous decade and both the research and regulatory activities have gone through a strong development process.

In 2001 Paks NPP will have an up-to-date FSAR that will be actualised periodically in the future utilising the best results of the nuclear technology of the world. Regulatory background has been built up to control this process.

8. Literature

1. Nuclear Safety Codes (in Hungary), Vol. 1. *Licensing procedures Applied to Nuclear Power Plants*
2. Decisions of HAEC and HAEA connected to the different kinds of SAR and PSRs and the approved documents of these decisions.
3. Present version of FSAR being evaluated by HAEA NSD before approval
4. A. Cserháti: *Status of Safety Analysis Reports in Hungary*, International Conference on Strengthening of Nuclear Safety In Eastern Europe, IAEA, Vienna, 14-18 June 1999.

APPENDIX NO. 2
CONTENT STRUCTURE OF THE FINAL SAFETY ANALYSIS REPORT

(BASED ON US NRC REG. GUIDE 1.70. REV.3.)

1. Introduction and general description of the plant
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        - 1.6.2. Piping and instrumentation diagrams
        - 1.6.3. Other graphic information
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